QUANTICA

The Building Blocks of Digital Manufacturing: Functional Materials and Precise Deposition

Ben Hartkopp

Founder, Inventor, Head of Research & IP

Offering Advanced Inkjet Technology for Challenging, High Viscosity Materials

Quantica delivers application driven inkjet systems, solving complex manufacturing challenges across diverse industries.

2018

Founded in 2018 with offices in Berlin and Barcelona.

IP Driven

Unique patented high viscosity technology, with 7 patent families filed, 2 granted.

Partners

Working with **top-tier research institutes** and **leading manufacturers** in various industrial sectors

Focus

Replacing analog manufacturing methods with a **digital, automated**, and **scalable** solution that **reduces waste** while **maximizing efficiency**.

Materials and Precision Building blocks in Digital AM

In an ideal world, digital AM delivers requirements for efficient production of high value objects:

- Can process specialized materials with specific requirements
- Can create functionality on the interface of multiple materials
- Can deliver precise arrangement for complex functionality
- Has high production efficiency through additive process and precision

But not all AM technologies allow

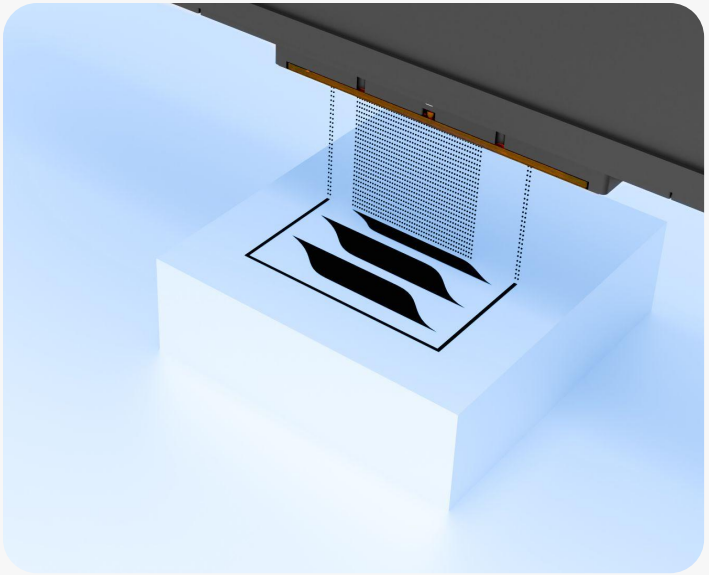
- Scalability
- Precision deposition
- Useful material selection
- Efficient and waste free production

Manufacturing Technology Landscape

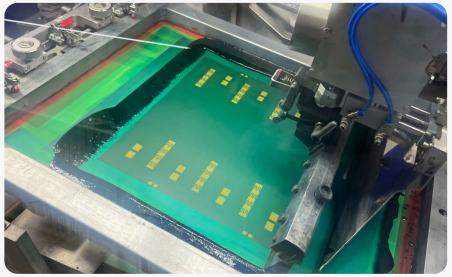
The limiting factors to scaling production are many:

- Limited throughput or coverage
- Substrate-interaction
  - Masking/Demasking
  - Heating
  - Direct Contact
- Pre/Post-Processing
  - Washing/Removal
  - Tool-change
  - Substrate Transfer

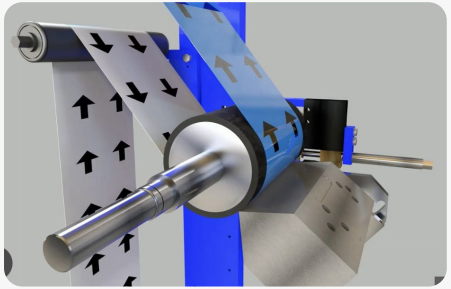
Spraying, dispensing



Inkjet



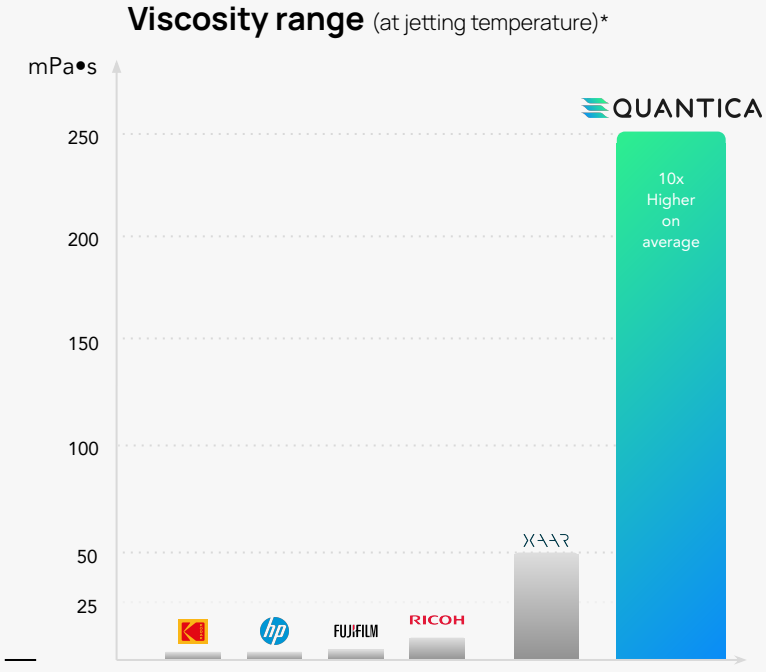
Screenprinting



Slot die coating

Inkjet Landscape

We go far beyond conventional inkjet printhead competitors by jetting functional materials that others can't.



High Viscosity Materials

Enable an avalanche of new applications

- Large prepolymers
- Composites
- High molecular weight
- High solid contents
- Large particle sizes
- High surface tension
- Solvent-, aqueous-, resin-based materials
- Novel chemistries

Novojet™ Printhead
Inkjet Technology

Proprietary, drop-on-demand inkjet technology, engineered by Quantica, manufactured by Xaar.

High Viscosity

Up to **250 mPa • s** (jet temperature), can translate to up to **15,000 mPa • s (room temperature)**

Large Particle Size

Handling larger particle sizes, up to **5µm D90**.

96
nozzle count

1.27mm
nozzle pitch

25-80C
operation temperature

Recirculation & Temperature Control

The Principles Behind NovoJet™

Strong Actuation

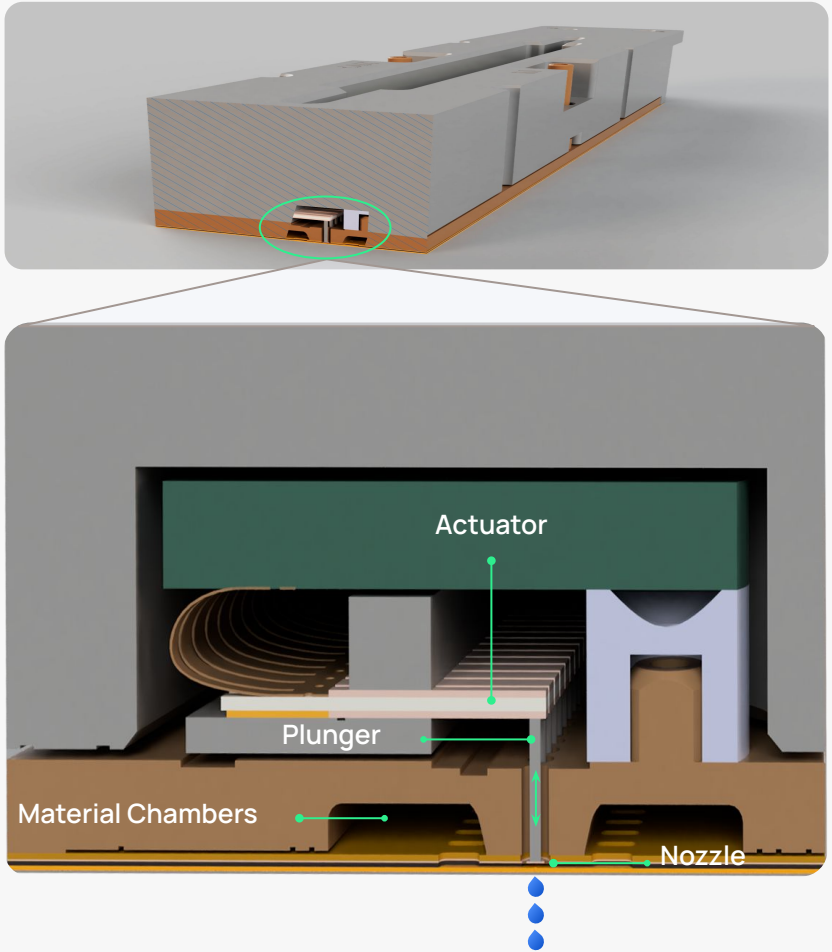
100x
Larger **actuation displacement** compared to conventional piezos.

60x
Larger **open perimeter** around to plenum compared to legacy inkjet heads

High
Volumetric material displacement at high frequencies.

Material Recirculation System

High flow recirculation allows high solid content without particle settling.

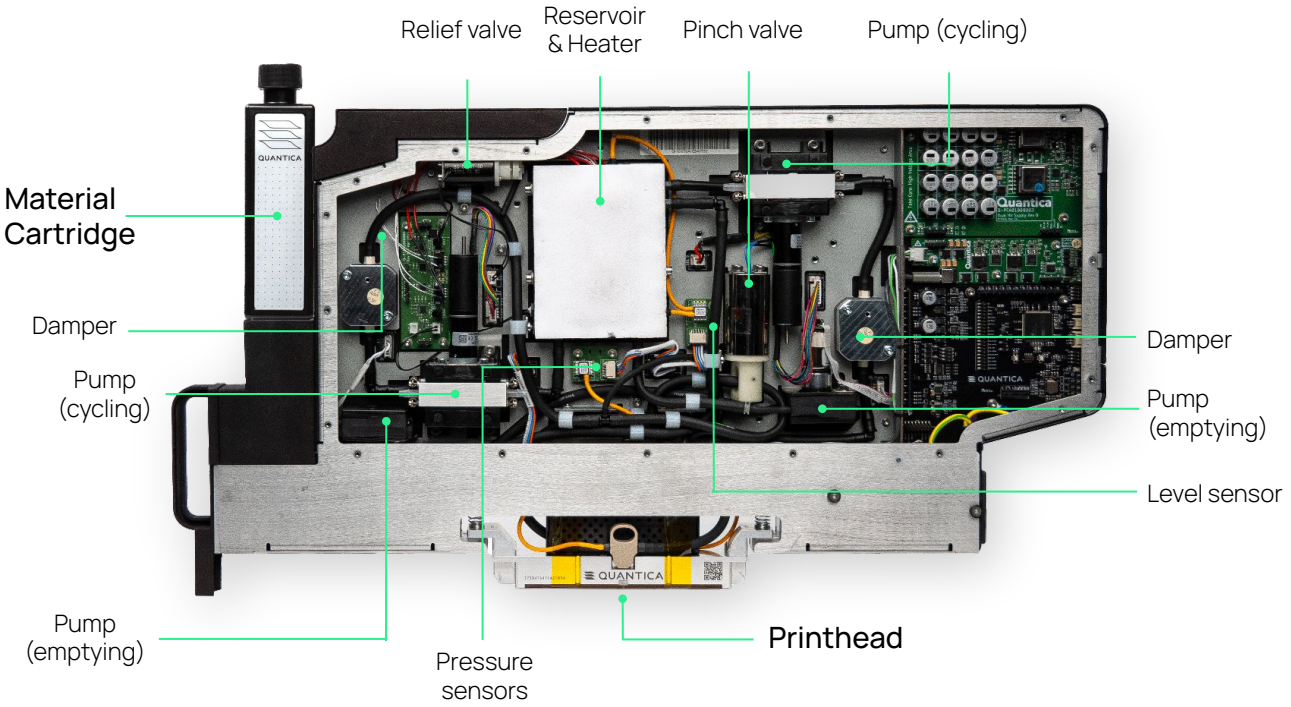


Material Management System

System for conditioning and jetting high viscosity material.

- Recirculation
- Filling, Purge & Emptying
- Temperature Control
- Cartridge Hot Swap

Module

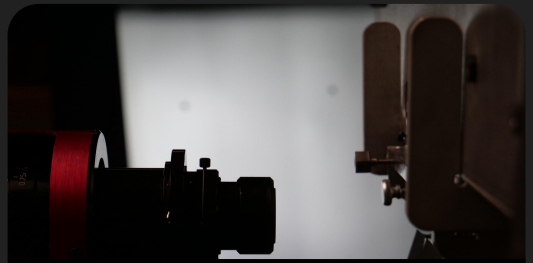


Application Development

We offer a full cycle application development service to bring your idea to life.

Material Qualification

Material qualification involves testing the compatibility and rheology characteristics to evaluate material suitability for further trials.



Jetting Trials

With the use of dropwatching systems, we observe and analyze the droplets formation, speed, volume and stability, to ensure viability for longer term printing trials.

Printing Trials

We test reliable jetting, deposition on substrates, curing and optimize printing parameters by executing printer based reliability procedures.

High Viscosity Complex Rheology

High viscosity materials frequently show increased viscoelasticity and non-newtonian characteristics.

The loss in energy transfer can not be overcome with classical piezo based systems.

Plate Rheometer

Complex viscosity Eta (circle) and elasticity % (triangle)*

PAV Rheometer

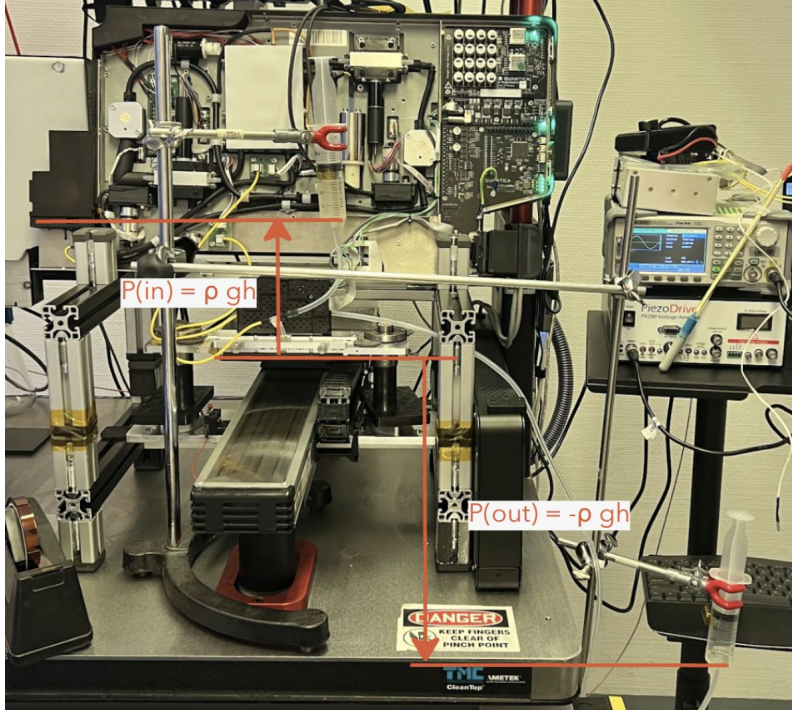
Time dependent viscosity at 10 1/s shear rate; 25°C (black), 50°C (red)

Precision Deposition

Precision requirements vary widely for each application

Ownership of full technology stack gives us a unique opportunity to tune:

- Jetting parameters
- Nozzle diameters for precision vs throughput, larger particle sizes
- Jet stability for larger printing distances



Lab Setup of JetPack with small volume gravity cycling setup in JetXpert Dropwatcher

Jetting and printing trials utilize:

- Dropwatching
- Confocal 3D-profilometry
- Contrast microscopy
- Heat-stability-, pressure/foaming-, material-compatibility-testing
- Raman-spectroscopy

Confocal 3D-profilometry of droplets on PET substrate

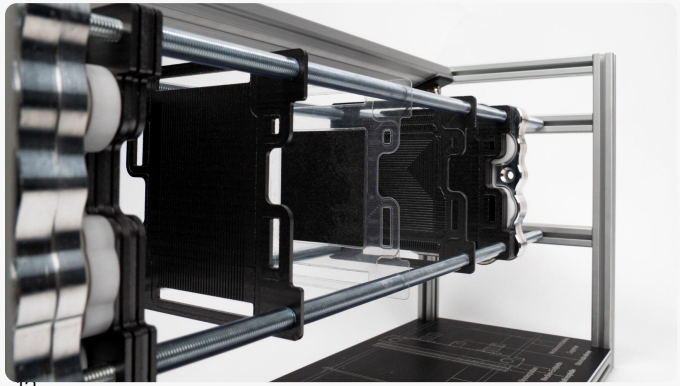
Case Study

Adhesive Deposition & Catalyst Layer

For Fuel Cell Manufacturing

We work with different customers on digitizing and optimizing processes for fuel cell production, replacing analog manufacturing methods for adhesive deposition and printing the valuable catalyst layer (> $10,000/L).

Quantica industrial adhesive sample



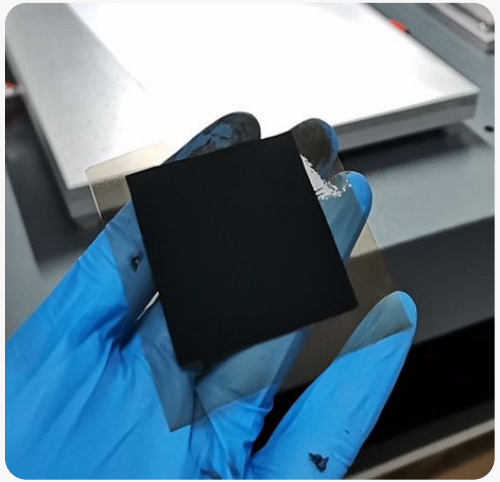
Quantica enables

- Use of existing materials
- Waste reduction
- Improved layer thickness
- Design freedom for better efficiency
- No additional tooling

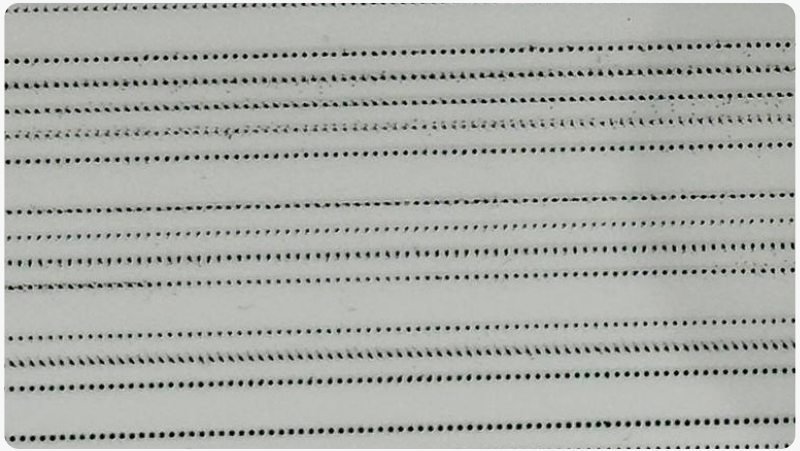
Materials

- Henkel Loctite Adhesive: 13,000 mPa • s viscosity at room temperature.
- Platinum Material: High particle content (~12wt%) with 150 mPa • s viscosity at room temperature.

Catalyst Layer
For Fuel Cell Manufacturing



Catalyst layer end result - Fraunhofer ENAS
(not yet printed by our team)



Jetting trials with catalyst Ink

USPs

Estimated **15% cost reduction** of fuel cell manufacturing with digital process

Improved layer thickness control compared to slot die coating

Design freedom for better efficiency

Material

Ink that mimics platinum catalyst - contains carbon, polymer, and solvents

High particle contents (~12wt%)

150 mPas at room temperature

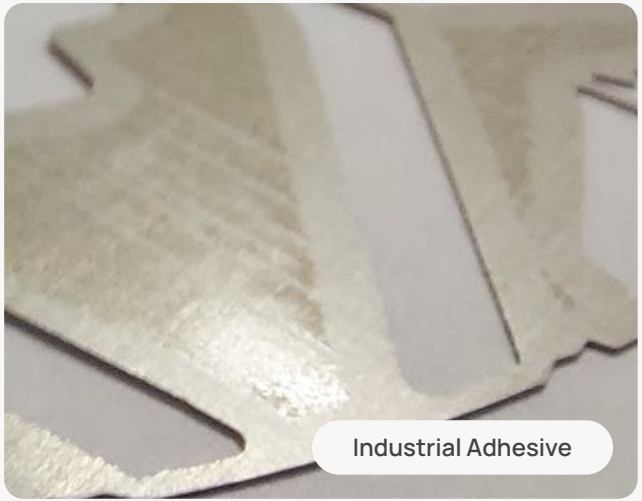
Valuable material

Case Study

Adhesive Deposition

For E-Motor Manufacturing

A multinational tech company in the automotive and industrial sector seeks to replace dispensing for applying industrial adhesive to e-motor lamellas during rotor assembly (200-400 lamellas per rotor).

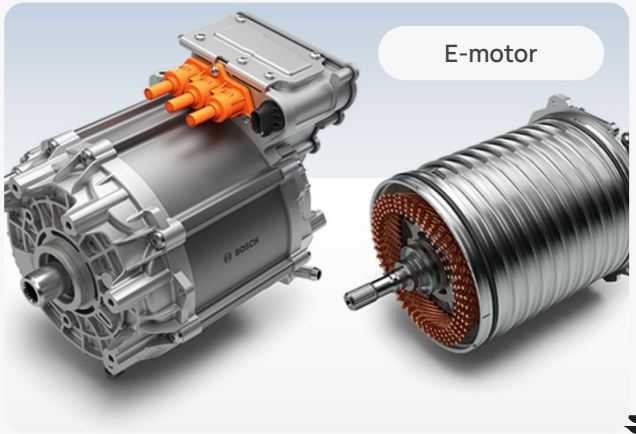


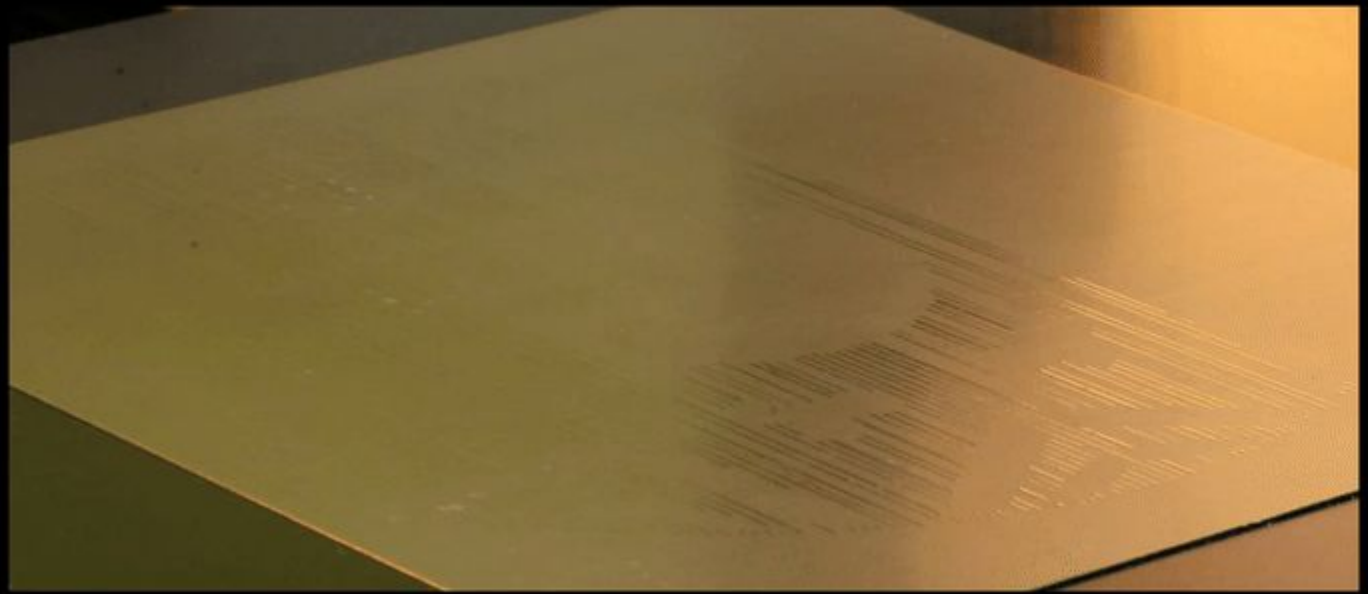
Quantica enables

- Higher Accuracy & Throughput
- Freedom to Design
- Reduced material waste

Materials

- Certified Material
- Viscosity: 85 mPa • s at jetting temperature
- Temperature Sensitive





Multi-Material Dentures
For Dental Partner

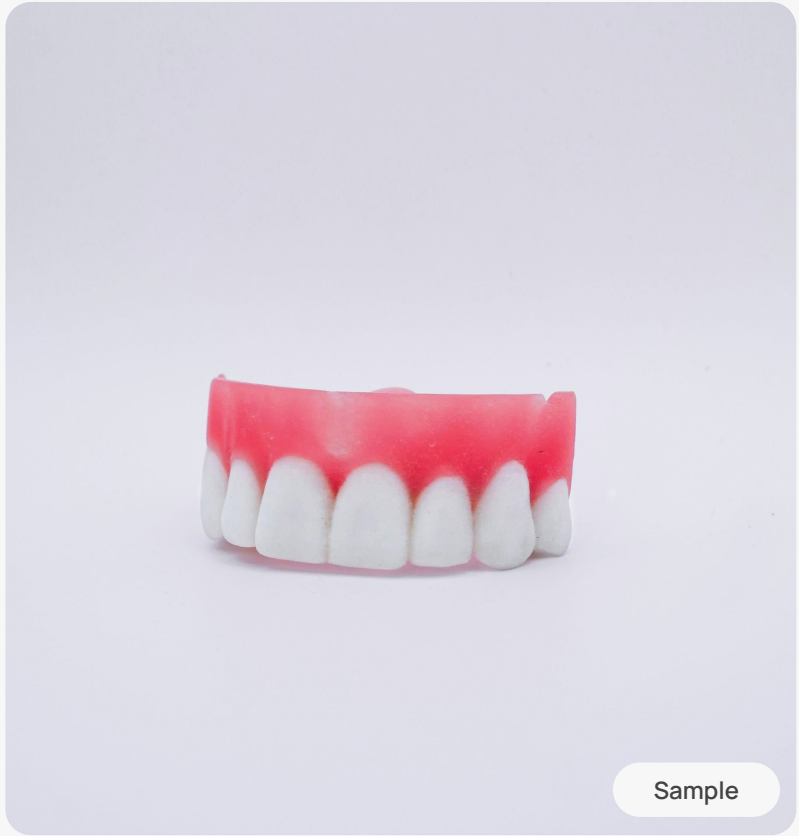
Partnering with a large European dental organization to develop a system to produce multi-material dentures with higher quality materials.

Quantica enables

- Improved Material Properties
- Multi-Material
- Less Tooling
- Mass Customization

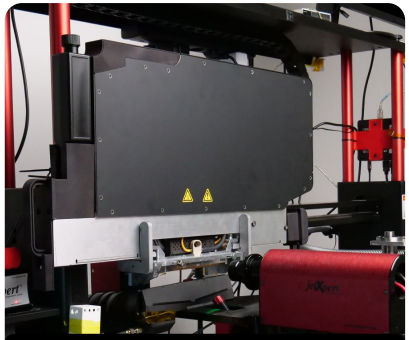
Materials

- Up to 7500 mPa • s at 25° C & less than 1µm particle diameter
- Certified Denture Material– Gum & Teeth
- UV Curable



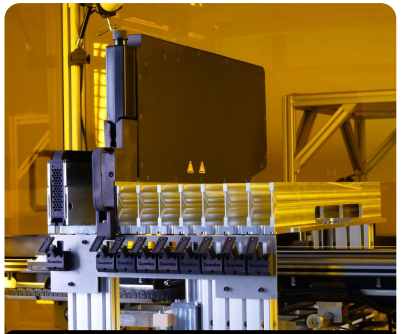
Systems

Test, print, and integrate with our proprietary hardware.



Print Module

For material validation and optimization



Printer

For application development

Print Engine

For high-volume production

Services

Bring your application to life.

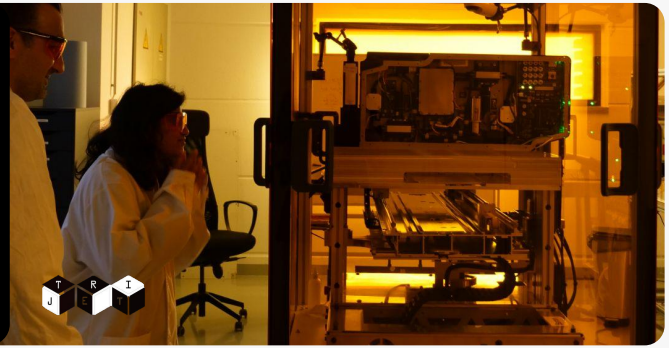
Application Development

Full-cycle application development

iPrint

DoDAct

Fraunhofer IPA



Print Engine

High Volume Production

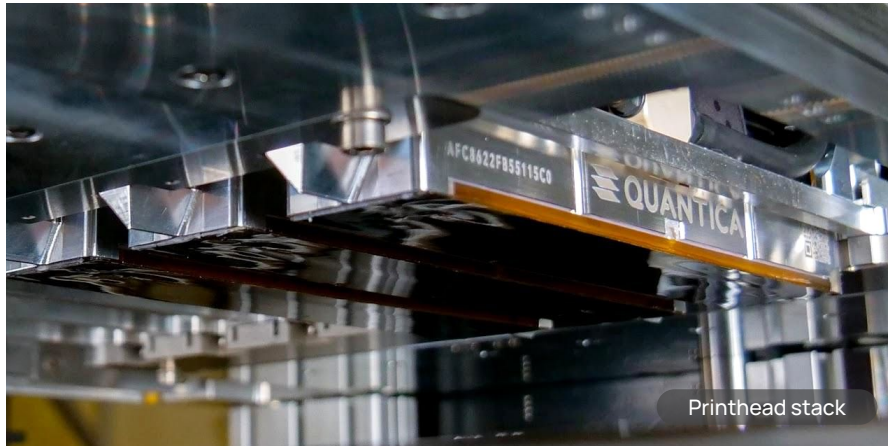
A high throughput printing unit, that combines multiple **printheads** and all required subsystems into **print bars** that expands into **print engine solutions** with throughput and native resolution, defined by amount of print bars in the print engine.

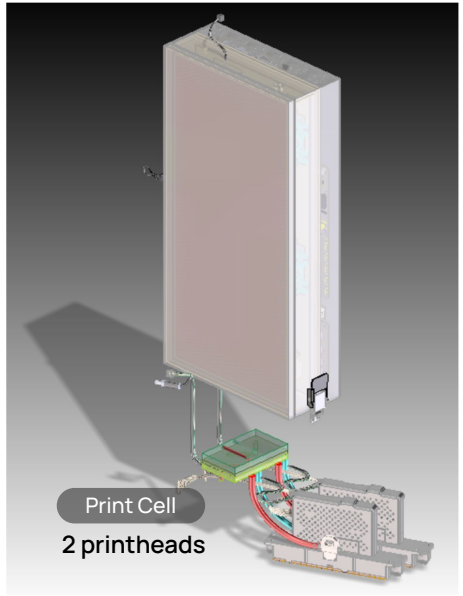
Industrial

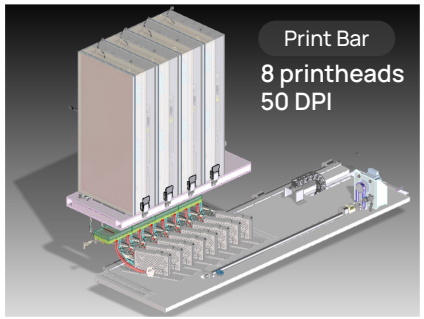
Modular system that can expand to achieve desired DPI and target takt time.

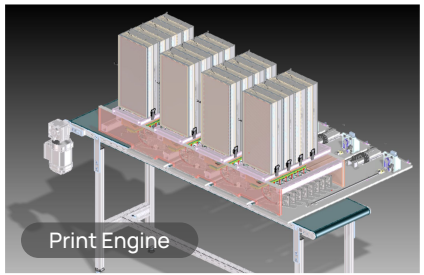
Integration

Designed for integration, service, operation and maintenance in industrial lines.



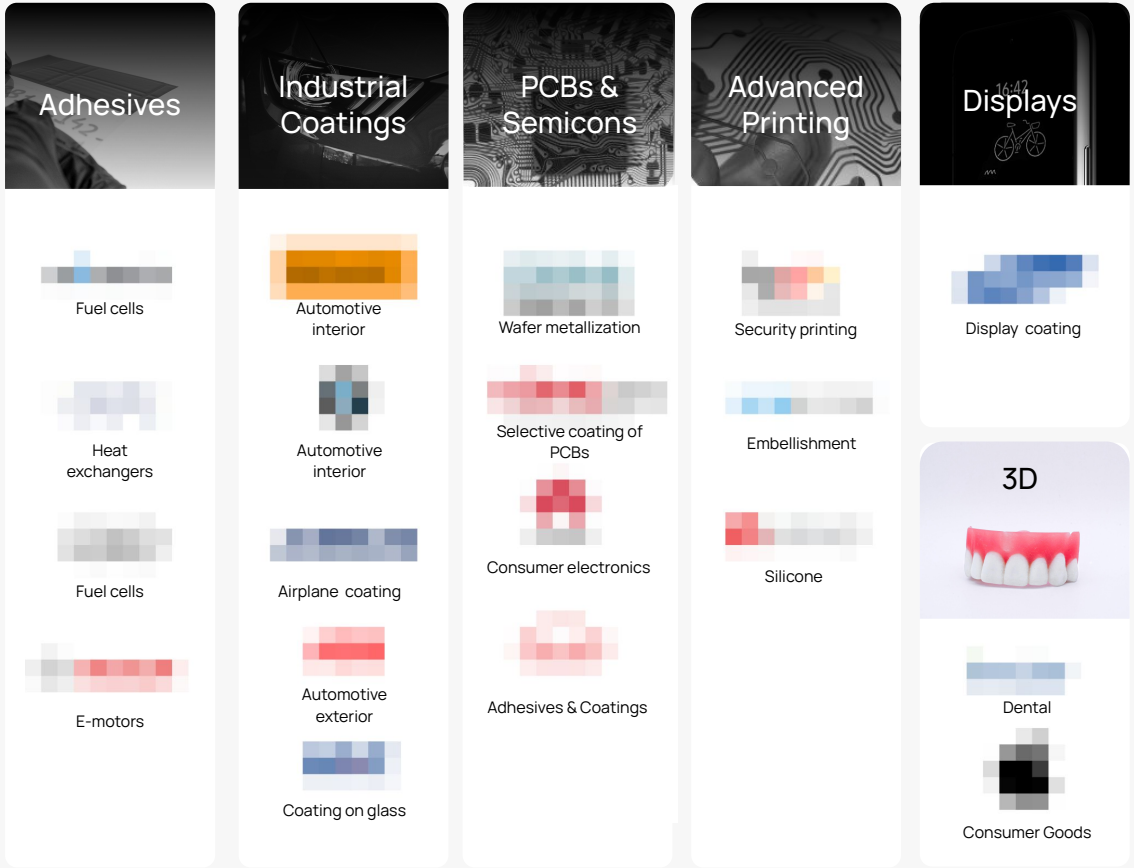






Looking Towards Future Applications

We collaborate with the **largest manufacturers in the world,** including 3 of the top 4 **automotive** companies, a globally recognized **aerospace** leader, and industry pioneers in **displays, semiconductors,** and **e-motor technologies**.



QUANTICA

Thank you

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